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PEST CONTROL AND PESTICIDES

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Contents

Weed Problems at Kariba

THE COMPLETION of the Kariba dam was hailed as a great technological achievement and the eighth wonder of the world. The ingenuity of the engineers who had turned the strange, mysterious, capricious, Middle Zambesi into the fifth largest lake in Africa and a source of eight thousand million kwh for the power lines of the Rhodesias was rightfully acknowledged.

But, as was stressed by several biologists when the scheme was first envisaged, nature has the knack of turning defeat into victory and creating fresh problems to tax man's ingenuity. The consequences of making such devastating disturbances to the ecology of the area are now becoming more widely realised.

Despite the warnings to the authorities, biological investigations carried out, before the dam was completed, were more or less confined to fisheries research but even on such an important aspect it was regrettably restricted. Subsequent events have shown that the lack of sufficient biological research—especially in ecology—before, during and after the filling of the dam, has proved costly.

Before the dam was filled it was predicted that the fertility of the newly flooded areas would result in an explosive multiplication of plant life yet only a few botanical studies were carried out. Unfortunately the predictions came true and the fern *Salvinia* finding the new conditions to its liking spread with a frightening rapidity. At the end of the first year's filling (December 1959) thousands of acres, particularly in sheltered areas and estuaries of tributary rivers, were covered, making navigation and fishing practically impossible. At the time it was feared that the weed would interfere with the breeding of fish because the water beneath the weed tends to become deoxygenated and because *Salvinia* thrives best in areas that are likely to be chosen by fish for their spawning grounds. These fears were soon confirmed and in January 1961 Mr. F. I. Parnell, Director of the Game and Fisheries Department of the Federation of Rhodesia and Nyasaland, reported that weed infestation (*S. auriculata*) on Lake Kariba was rapidly reaching emergency proportions and had already closed down several fishing stations on the lake. The Kariba Lake Co-ordinating Committee are now investigating the problem in a variety of ways, Field trials in ponds have shown that *S. auriculata* can be successfully controlled with herbicides and it has been stated that their use offers the best immediate remedy for the problem.

Moreover, checking the growth of *Salvinia* by chemical (or density independent) methods would give the scientists more time to find a suitable method of biological control (density dependent).

THERMAL FOGS, MECHANICAL AEROSOLS AND AEROSOL BOMBS

In the first part of this article, published in our January issue, the author dealt with the early history—pre 1940—of concentrated spraying. He now traces the development of present day fog and aerosol generators from their origins in the days of the second world war.

By B. J. G. ROSE,* B.Sc., F.R.E.S.

SCIENTIFIC study of thermal fogs began with the work of Sullivan, Goodhue and Fales of the United States Department of Agriculture some twenty years ago[1-6]. These workers have shown that dense and potent fogs could be produced by spraying solutions of insecticides such as rotenone and pyrethrum on to a hot metal plate. The laboratory experiments of these research workers clearly pointed the way to the development of insecticidal fogging equipment scaled up for commercial pest control operations but the development of such equipment, in fact, took a somewhat tortuous path.

Two distinct types of thermal fog generators have in fact been produced :—

(i) those which convert the insecticidal solution into fog by means of hot air and heated surfaces, i.e. " TIFA ", " Swingfog ", " Dyna Fog " etc.

and (ii) those which convert the insecticidal solution into fog by the action of superheated steam, i.e. " Bes-Kil ".

The " Bes-Kil " machine was based on work carried out by Hockberg-La Mer during the period 1939-44 and is a complicated apparatus driven by a 6 h.p. petrol engine[7]. The engine drives a two-cylinder, plunger-type pump. One cylinder of the pump forces water through a continuous-flow steam generator for which heat is supplied by an oil burner. The other cylinder pumps the insecticide to the fog nozzle of the machine where it is converted to fog by the action of the superheated steam expanding at considerable velocity. The machine uses 31 Imperial gallons of water per hour, 4 gallons of diesel oil and a quarter of a gallon of petrol to convert 31 gallons of insecticide to the fog form. The particle size of the fog can be altered by varying the steam temperature — the higher the temperature, the smaller the size of the fog particles.

The dry weight of the " Bes-Kil " machine mounted on skids is 660 lbs. and as will be appreciated from the above description it is a complicated machine needing a considerable supply of water for its operation.

TIFA

Most machines in commercial use today are based on the use of hot air and heated surfaces for conversion of the insecticide to the fog form. The Todd Insecticidal Fog Applicator, fortunately known at TIFA for short, was the first machine to be introduced on a large scale and was developed in America. The " Swingfog " machine of German manufacture appeared later but like TIFA originated during the war years. As a result the details of their early history is still somewhat confused and obscure.

During World War II, the Combustion Equipment Division of Todd Shipyards Corporation was asked by the U.S. Navy to develop smoke screen generators to produce large clouds of low hanging, long lasting fog. This they did by injecting a regulated feed of a special oil through a mechanical atomiser so as to meet a blast of hot air. Even before the war was over the idea of

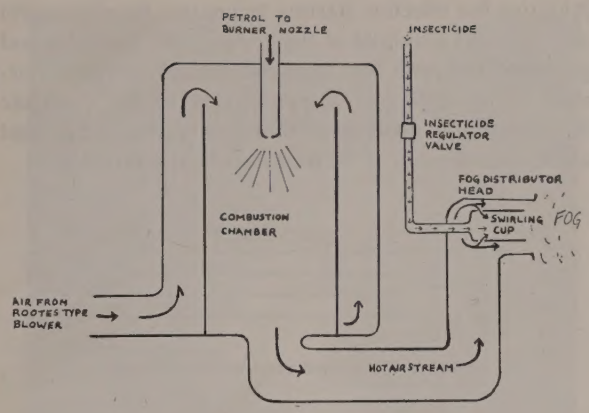
* *Editor, Agricultural and Veterinary Chemicals.*

using these smoke generators to disperse insecticides was mooted and tests carried out in Arizona in 1945 soon proved that the idea was feasible[8]. Work on adapting wartime smoke screen generators to a form suitable for dispersing insecticides as fogs was then carried out and in June 1946 the availability of TIFA was announced[9]. A few years later Todd Shipyards of New York and R. A. Lister & Co. of Dursley formed a joint company, The Lister-Todd Engineering Corporation Ltd. to manufacture TIFA machines in England and to export them to Commonwealth and certain other countries.

The stream of hot air in the TIFA machine is produced by passing a constant volume of air from a Rootes type blower through a combustion chamber in which the heat source is provided by burning finely atomised petrol. The hot air (temperature 900-1,100°F) issuing from the combustion chamber passes to the fog distributor head. In the distributor head, the hot air and insecticide meet. The insecticide is injected into the base of a stainless steel cup where part of the hot air stream entering the cup through six tangential holes swirls the insecticide round the inner surface of the cup and spins it off the rim of the cup into the main stream of hot air passing round the cup. As a result a dense cloud of insecticidal fog is produced (Fig. 1). The mass median diameter of the fog particles can be varied by altering the amount of insecticide solution passing to the fog head ; the more solution passed the larger the particle size. The standard model of the British TIFA weighs 760 lbs. and is driven by a 6 h.p. engine. The amount of insecticide dispersed per hour varies from 16½—53 Imperial gallons. A smaller model, the Lightweight TIFA, is now available. It weighs 250 lbs. fully laden, is driven by a 3½ h.p. motor and has an insecticide dispersal rate of 8—35 Imperial gallons per hour.

A second type of thermal fog generator was developed during the war specifically for mosquito and fly control by the U.S. Army and utilized the heat and pressure of the exhaust gases from motor vehicles to convert an insecticide solution injected into the hot exhaust into fog. This development heralded an era of inventiveness in the field of what are known as exhaust *aerosol generators* of *plumbers nightmares,* the latter being available as "ordinary" "adult" and even "king size" nightmares[10 11 12 13 14].

The particle size of fogs produced by this method depends on the running speed of the vehicle's engine, the temperature and volume and rate of flow of the exhaust gases as well as on the feed rate and physical characteristics of the insecticide solution. The latest development in this field is a design by H. J. Sayer developed for locust control and generally recommended for use by the 8th Session of the FAO Technology Advisory Committee on Desert Locust Control meeting in Rome in June 1958. The special nozzle of the equipment which is attached



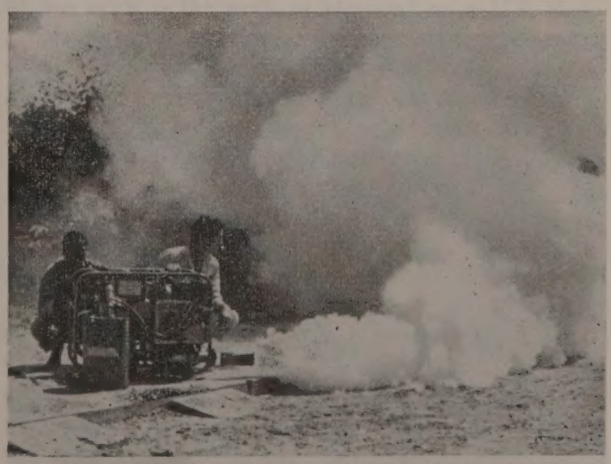
Principle of fog production in the TIFA

to the exhaust pipe of a Land Rover amplifies the velocity of the exhaust gases and converts insecticide mixed with them into fine fog particles. Using a 20% solution of dieldrin in oil this apparatus has given excellent control of desert locusts. Fitted to a vehicle travelling at 5 m.p.h. the sprayer gives a swathe of 120 yards in a 5—10 m.p.h. wind and produces an average deposit of about ¼ pint per acre. The apparatus is now produced commercially in England by Messrs. Evers & Wall Ltd.

Swingfog and Dynafog

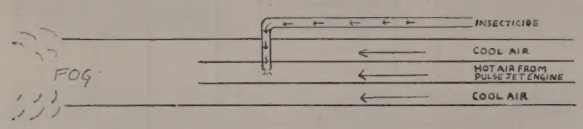
The interesting story of "Swingfog" goes back to the winter of 1942 when the German Army froze to a halt when winter descended on the Russian steppe.

During the period of intense cold neither the Russians nor the Germans could start the engines of their tanks or other armoured vehicles. The Russians desperate and conditioned to a policy of scorched earth, evolved a



The lightweight TIFA applying an insecticidal fog to a rubbish dump in Portuguese East Africa. Photo Lister-Todd Engineering Corporation.

primitive but effective starting technique. Pouring petrol over the inlet manifold of the engines they ignited it and generated sufficient heat to enable the fuel to be vapourised. This technique inevitably led to the complete destruction of a good many tank engines but did at least allow some armour to be used in the coldest weather.



Principle of fog production in the Swingfog.

The Germans with a more sensitive respect for mechanism were reluctant to employ the Russian technique and through the bewildering chaos of their administration, cried out to the high command in Berlin for technical assistance. The German high command asked a research team in Stuttgart to develop a pre-heating device for attachment to tank engines. The team which tackled the problem was led by Professor Kamm[15], the designer of the pre-war Auto-Union racing body. Professor Kamm had as his chief assistants Huber and Durr. This team developed a pre-heating unit based upon the pulse jet apparatus patented by Paul Scmidt in 1928. (See Part I).

The heater consisted of a tube, a pressure fed fuel injector, an air port with non return valve and a sparking plug and hot point for ignition. The hot exhaust gases from this pulse jet were directed into the inlet manifold to provide enough heat for initial vapourisation of the tank fuel.

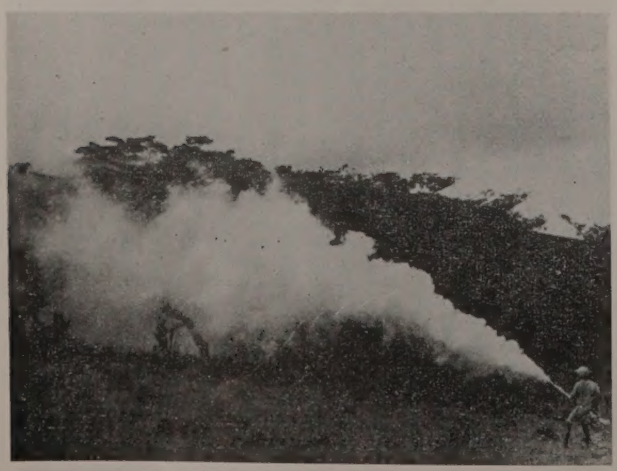
An efficient practical heating unit was not finally developed until too late to play any effective role in the war. The pulse jet engine was modified by the German Rocket research team as a power unit for the V1 flying bombs whose pulsing note became all too familiar in the sky over London.

After the war Professor Kamm left Germany for the United States and Huber and Durr of the original team working under Dr. Lafferenz continued their research on the heater which they called Swingfire adapting it for domestic use. It was developed first as an aid to starting for buses, lorries, and motor cars in the north of Europe and later, in 1948, as a general water heater[16].

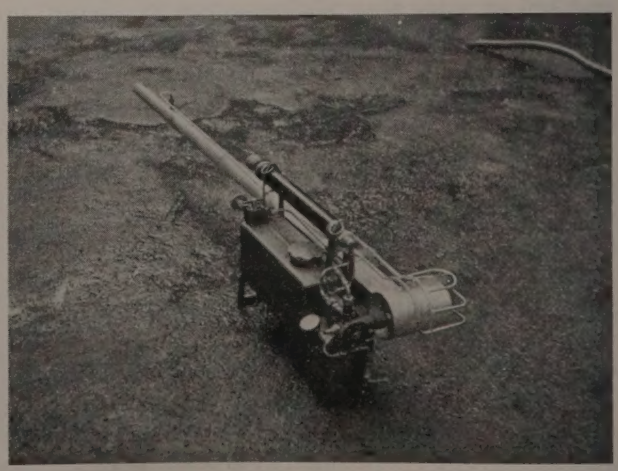
The Swingfire team carried out a series of improvements upon the original pulse jet engine. It was found that the use of a small diameter inlet tract extending into the combustion chamber had a two-fold advantage. It provided a means of preheating the mixture before the ignition point and also served to provide a column of air which cushioned the shock of combustion and permitted the use of a very light plastic diaphragm in the inlet valve. The petrol tank was sealed and slightly pressurised by the unit itself. A fairly normal type of carburettor supplied the fuel through a jet. It did, however, include a means of increasing the pressure within the float chamber for operation in cold temperatures. For starting an electrically heated glowplug remained hot due to the combustion of the charges. This unit was used as a means of heating water and when attached to an engine would warm it very quickly. It produced $7\frac{1}{2}$ kilowatts for a fuel consumption of $1\frac{1}{2}$ pints of petrol per hour, this representing an efficiency of over 90%.

The Swingfire works was situated at Ueberlingen on the Bodensee. Bodensee, the inspiration of generations of romantics, is beautiful but at certain seasons pestilential. Bodensee is also the region of the great summer houses of many German industrial magnates. Magnates escaped the febrile tenor of their city offices only to be eaten alive during the season by hordes of indiscriminating mosquitos.

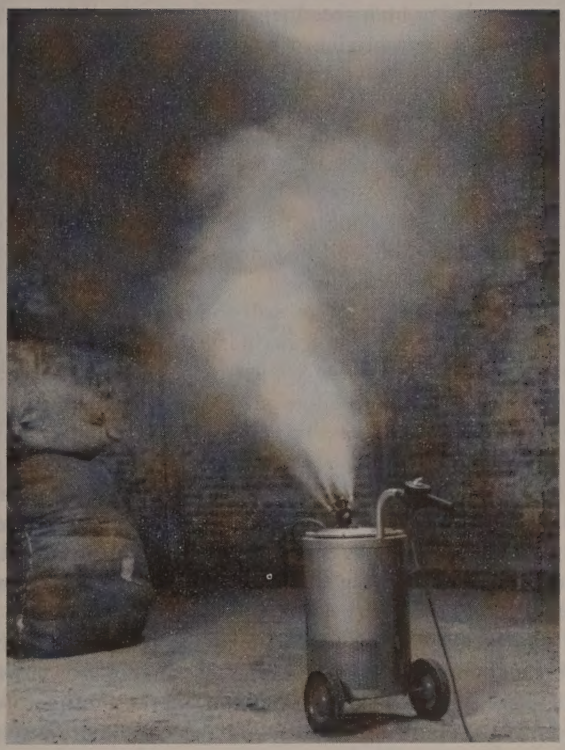
Conscious of the problem outside his door and of the



The Swingfog in action.



A close-up view of the Swingfog. Photos Jaydon Engineering Co. Ltd.



Above: Model 303T Microsol Mechanical fog generator normally used for indoor disinfestation is seen here in an unusual situation—applying pyrethrum to combat a plague of caterpillars in Berkeley Square. Photo Silver Creek Precision Ltd.

Right: The 'Spacemaster', a high speed jet aerosol machine for indoor disinfestation work. Photo West Chemical Products.

appearance of the thermal aerosol generators outside Germany, Streetmatter of the Swingfire works constructed in 1950 the first " Swingfog " machine. The " Swingfog " (Swingfeur Nebel Gerat) was based upon the water heater but included a non-spill carburettor. The exhaust pipe which had previously been a heater coil to warm a water bath was straightened out and pressure taken through a non return valve from the inlet tract was used to pressurise an insecticide tank. The spray diluent used was a light oil of the gas oil type and this was led from the tank via a hand controlled needle valve to a jet which protruded into the exhaust pipe near the open end. The combustion chamber and exhaust pipe were jacketed and this outer pipe extended a few inches beyond the exhaust pipe opening. Cooling air was drawn over the combustion chamber and exhaust pipe by the extractor effect of the exhaust gases. The extended end provided a further mixing and heating area for the fog before it emerged. Eventually a magneto was developed for ignition.

The swingfog unit is capable of a throughput of 5—6 gallons of insecticide per hour emitting droplets in a range from 10—45 microns v.m.d. depending upon setting of the liquid control.

The " Swingfog " has been very important in extending fogging practice since it is a continuously operating thermal fog generator that can easily be carried by one man.

Professor Kamm's early work upon the pulse jet heat provided certain design notions which undoubtedly influenced the design of the Dynafog unit in the U.S.A. circa 1949 by Tenney[17]. Although in principle identical to Swingfog, " Dynafog " is of less complex design being a straight through system nearer in conception to the original pulse jet.

Mechanical fog generators

The last of the wartime research meriting discussion at this point is the work of Hession[18] on a U.S. Navy project for transforming sea water into fog. Hession developed a machine consisting of a rotary atomiser made up of a number of thin discs held together with a very small gap between them. Liquid fed into the gap between the discs is spun by centrifugal force to their periphery and as it is flung from the rims of the discs it is atomised by an air stream produced by an axial flow fan. The size of the droplets produced depends on the liquid feed rate, the diameter of the discs and the speed at which they revolve. Laurence Schmidt in 1949 redesigned and scaled down the U.S. Navy mechanical fog generator which was marketed as the Microsol Mechanical Fog Generator by the Silver Creek Precision Corporation. The smaller models for indoor disinfestation work are electrically operated. Larger models are powered by petrol engines.

Recently an electrically operated mechanical fog

generator using high speed jets to atomise the insecticide solution has been produced by West Chemical Products.

Aerosol bombs

A wartime development which has precipitated a large industry and which cannot be divorced from the notion of concentrate spraying is the gas filled aerosol bombs. Goodhue and Sullivan[19] first tested the method in 1941 against flies and mosquitoes.

In the conventional aerosol bomb the insecticide is dissolved with the aid of auxiliary solvents, in a liquid propellant of low boiling point which is held in a closed container. Dichlorodifluoromethane is the material usually employed. The propellant boils at 29.8°C and exerts a vapour pressure of 67.5 lb. per square inch at 20°C. This pressure is sufficient to deliver the contents through a capillary discharge tube with a small orifice to the outside air. As it is sprayed a mist forms and the gas evaporates leaving the insecticide suspended, as fine particles, in the air.

One factor which tended to delay the acceptance of the aerosol bomb by the professional glass house grower was its price. By 1945 the domestic market for aerosol bombs was growing rapidly and the consumer seemed prepared to pay for a relatively costly expendable container each time he purchased his ration of insecticide. In the domestic consumer's mind the convenience of the aerosol bomb far outweighed the expense. The commercial grower, working sometimes on doubtful profit margins, and spraying frequently, was prepared to substitute sweat for convenience and continued to employ traditional methods. In Britain, a firm which had long been specialising in the supply of chemicals to the glasshouse grower, Pan Britannica Industries Ltd.,[20], gave this problem a good deal of thought. Towards the middle of 1945 Pan Britannica in conjunction with Messrs. Schweppes Ltd., produced their first "Aerocide" container. This container bore a certain similarity to the soda-siphon which can be charged with tap water and then livened with carbon dioxide from screw-on cassettes. A relatively small initial expenditure allowed the commercial grower to purchase outright an aerocide container which he could refill with spray material dissolved in a volatile solvent and sold in a cheap can. The charged unit could then be pressurised by screwing on a carbon dioxide cassette. Provided with a simple efficient trigger valve the mode of action is similar to that of the aerosol bomb.

Uses of fog generators

Although fog generators have some agricultural uses the absence of any positive method of directing the fog to the target has limited their use for the control of agricultural pests. They have however proved very effective for control of a number of pests defoliating forest and plantation trees as the forest canopy holds the fog and enables satisfactory coverage of the foliage to be obtained[21]. Aerosols are widely used for the application of both insecticides and fungicides to crops grown under glass.

The main use of fog generators has been control of public health and industrial pests both indoors and out of doors. Flies, mosquitoes, cockroaches, tobacco moth and tsetse flies are among the many pests which have been successfully controlled by the fog method. Fogging has even been used to control exctoparasites of sheep.

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TICKS, MITES AND DISEASES

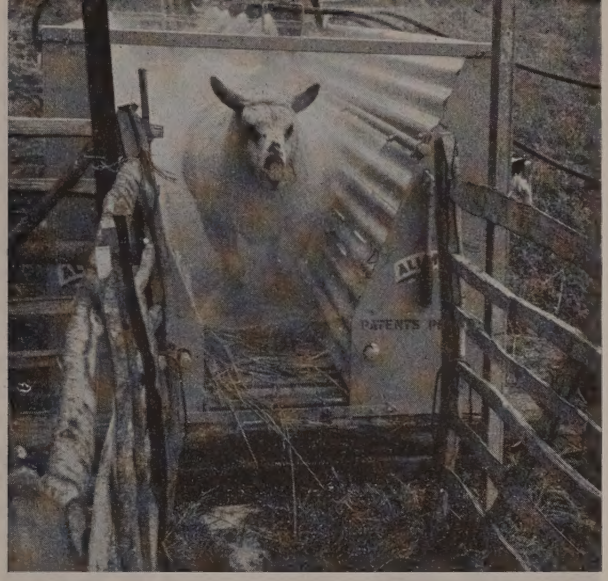
Part III—CONTROL

By G. Lapage, M.A., M.D., M.Sc.

TICKS AND MITES are controlled by chemical contact poisons, called acaricides, which are applied either (i) to the hosts while the various stages of these arachnids are feeding on them, the hosts thus collecting the parasites, so to speak, into a small area where they can be conveniently attacked; or (ii) to the soil, vegetation or human and animal habitations while the various stages of the arachnids are sheltering in these situations. However, before we consider the actual substances and methods used for these two lines of attack, it will be helpful if we first enumerate the chief properties that an efficient acaricide should possess.

Acaricides are used either as dusts, creams, emulsions, suspensions or solutions. Creams are used chiefly for treating restricted areas on the hosts and are usually applied by hand. Dusts are applied either by hand or nowadays more frequently by means of some form of mechanical duster. Solutions, suspensions or emulsions may be applied—to domesticated animals at any rate—either by mechanically operated showers, jets or sprays or in the form of baths (dips) through which the animals are made to pass—a time honoured method which is still the cheapest and the one best adapted to local farming conditions in many parts of the world. But whatever the method of application considerable quantities of acaricide will be required to treat flocks of sheep or herds of cattle, so that it is an advantage if the acaricide is cheap and is either readily soluble in water or can be easily suspended or emulsified.

Apart from the cost, however, experiment has shown that some acaricides are more effective as emulsions, some as solutions, some as dusts and others as supensions much depending on the species of parasite and its host and on such factors as whether the host is covered by hair, wool, feathers etc. The formulation of the acaricide is therefore important. Its strength in the formulation used is also vital and this must be conserved. One of the disadvantages of dips is that they are often left exposed to the air and other climatic effects for long periods of time, so that the acaricide in them is often

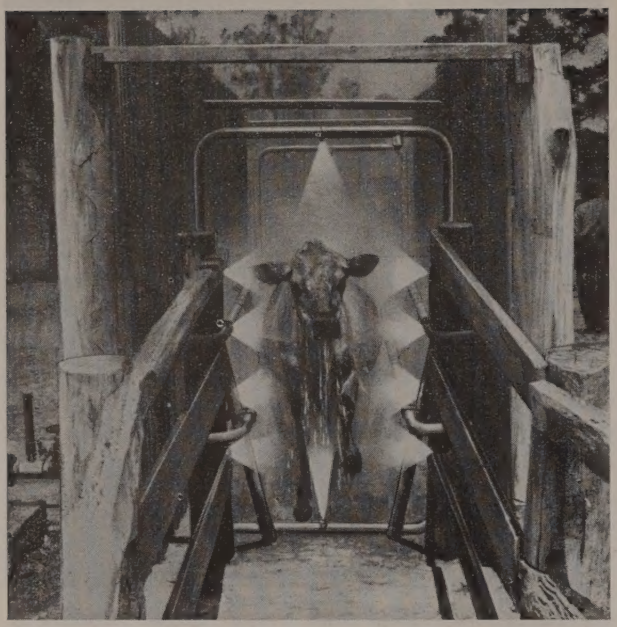


The Cooper Allman Sheep Shower. Photos: Cooper, McDougall & Robertson Ltd.

affected by evaporation, dilution by rain (especially in tropical areas) etc. Also when the dip is used more than once it becomes contaminated with dirt, hair, wool, excreta and other debris derived from the animals that pass through it and its strength and efficiency are thereby reduced. It is necessary, therefore, to make sure that, before the dip is used, the strength of the acaricide in it is the strength determined by laboratory and field experiments to be the most effective one; it is an advantage if the acaricide used is one whose strength can be tested by relatively simple tests, preferably at the dipside.

One of the most important properties of an acaricide is its residual action, namely, the length of time during which it remains effective against the parasite after it has been deposited on the wool, hair, feathers or skin of the host or, when the environment is being treated, on the vegetation, soil or other surfaces. Thus arsenic which was, until fairly recently, the only acaricide really effective against ticks is readily soluble in water but it has practically no residual action and hosts treated with it soon become re-infected. DDT on the other hand, will remain on cattle and retain its lethal effect on tick larvae for a week after cattle have been dipped. When cattle are treated colloidal preparations of DDT are more effective than the wettable powder formulation, because they form heavier deposits on the hair and therefore have longer residual effect.

Some acaricides are more effective against some species of arachnids than they are against others; and some are more effective against certain stages in the life history. Thus DDT is less effective against adult female ticks of some species while they are sucking blood and also against the older nymphs, so that, under certain circumstances, the female ticks may escape the effects of the acaricide to drop off the host and lay eggs from



The Cooper Allman Spray Race for cattle.

which further generations of ticks develop. BHC on the other hand is effective against all stages of susceptible ticks, but its residual action is shorter than that of DDT. Moreover, it may also be effected to a greater extent by excreta and other contaminants left in the dip after treatment of the animals. Toxaphene, dieldrin and some other related chlorinated hydrocarbons have, in general, a killing effect comparable to that of BHC and their effect against some species is better.

It is so clearly important that any acaricide used should not be unduly poisonous to the animals treated and to the personnel applying it that this point need not be stressed.

The acaricides most commonly used at the present time for the control of cattle ticks are arsenic, BHC, toxaphene and DDT. In those areas where tick resistance is a problem organo-phosphorous compounds such as diazinon, coumaphos, and dioxathion are being introduced. The commonest tick in Great Britain, *Ixodes ricinus*, can be controlled with either DDT or BHC. DDT has the longer residual action of the two, but BHC has the advantage that it will also control *Psoroptes communis* var, *ovis*, the mite causing sheep scab and would be prefered if there were any likelihood that this might occur. However, the eradication of sheep scab from Britain has technically speaking, neutralised this advantage, although annual anti-scab dipping must still be carried out to comply with the law. More recently successful control of *I. ricinus* in Britain has been obtained with the organo-phosphorous compound dioxathion, the residual action of which is longer than that of DDT or BHC.

Resistance

An important problem in the control of ticks is the fact that one species of them at any rate, has evolved the ability to resist the action of several acaricides. This species is the dangerous blue tick, *Boophilus decoloratus*. As long ago as 1937 a strain of this tick appeared which could not be killed by the arsenical dips then in common use. When attempts were made to overcome this resistance by using BHC instead of arsenic, after some time and in some places, a strain appeared which was also resistant to BHC. This strain was, to some extent, also resistant to toxaphene. These strains of the blue tick, however, were not resistant to DDT, so that it was possible to use this for their control. But in 1954 it was found that there was, on some South African farms, a strain of the blue tick which was resistant not only to arsenic and BHC but also to DDT. Much research was carried out on this problem, which is analagous to that of the resistance of many insects to insecticides and ultimately a solution was found among the organo-phosphorous compounds. In South Africa it was found that the chloro-coumarin-thiophosphorester, coumaphos, (and subsequently diazinon and dioxathion) controlled not only the resistant strains of *B. decoloratus* just mentioned, but also other cattle ticks. Trials with this compound extending over three years showed that it does not affect the health or milk yield of cattle. Fortunately *B. decoloratus* is the only tick which has so far evolved resistance of this kind.

Application

Whatever the method employed the application of acaricide to flocks of sheep or herds of cattle is laborious. The animals have to be rounded up and each one has to be carefully treated. Considerable care must be taken to ensure that every part of the animal is thoroughly wetted and when the parasites attach themselves to certain specific parts of the hosts' bodies, it is important to see that these parts of the body are thoroughly treated. The animals have to be penned up before they pass, one by one, through the apparatus used and care must be taken to see that they are not frightened and do not, for this reason, injure themselves. Pregnant and young animals are especially liable to injuries aquired in this way. A great deal of skill and experience is therefore required to carry out treatment efficiently and the number of men needed and the cost of their labour must be taken into account. It is not surprising, therefore, that methods of applying acaricides have been devised which lessen the labour costs and minimise the risks associated with the older practice of passing the animals through dips. Briefly stated the improvements have been that the animals are made to pass through apparatus in which controllable nozzles direct sprays, jets or showers of acaricide on to the animals. The acaricide is pumped to the nozzles by power supplied by some form of engine mounted on a tractor or other vehicle, the whole apparatus being, in some

instances portable, so that it can be taken to the animals, the greater task of bringing the animals to a dip being thus eliminated.

Another advantage possessed by some forms of this kind of apparatus is that the acaricide running off the animals is automatically collected and re-circulated for further use; also it can be tested before it is used again to make sure that its strength is maintained. The re-circulating liquid is also filtered to remove hair, wool and other contaminating material. One such piece of equipment is the Cooper-Allman Sheep Shower, which holds sheep in a pen and directs on to them a shower of acaricide from nozzles above and below the animal so that the fleece is thoroughly saturated and the effect is similar to that of a dip. Another type of apparatus is the Cooper-Allman Spray Race, in which the animals pass through a fine spray of acaricide. The spray will not penetrate the fleece of sheep, but will effect thorough wetting of cattle.

The decision as to whether apparatus of this kind or the more old fashioned dip will be employed depends on local farming conditions, on the cost of the apparatus and on whether the labour available (e.g. native labour) is able to operate the newer forms of apparatus efficiently.

Seasonal dipping

The times of the year at which dipping is done are related, as are other aspects of control campaigns, to the life histories of the parasites. Generally speaking dips are applied when the parasites are most numerous on their hosts. A good example of the successful application of knowledge of the life history of the parasite to the dipping programme is provided by the practice of "strategic dipping" so successfully used for the control of cattle ticks in Queensland, Australia. This practice takes into account the fact that the female ticks dropping off cattle in the autumn to lay eggs, will produce larval ticks to attack cattle during the following spring. Therefore dips applied in the autumn may be expected to kill off many of these female ticks and thus reduce the number of larval ticks which survive through the winter to attack the cattle in the following spring. It was, in fact, found that autumn dippings, applied at intervals of about $3\frac{1}{2}$ weeks until late December or early January, did reduce the larval ticks on the pastures to negligible numbers, because the larvae were either picked up by the cattle and were destroyed by the winter dips, or they were killed by climatic effects. The numbers of ticks feeding on the cattle in the spring consequently remained small and were easily controlled by a few dippings at comparatively long intervals. These results were compared with those obtained with another herd of cattle which was not given autumn or winter dips but was dipped according to the usual practice i.e. only when the cattle became visibly infested with ticks. It was found that the omission of the autumn and winter dippings resulted in heavier infestations during the following year, so that the infestations were less easily controlled.

Strategic dipping of the kind just indicated has been combined in Australia with what is called "spelling" of the pastures, a practice which is based on studies of the periods of time during which the various stages of the ticks can survive away from their hosts. When these periods of time are known, it is possible to plan systems of rotational grazing which keep the farm animals off tick-infested pastures for periods long enough to ensure that, when the animals are returned to the pastures, all, or most, of the stages of the immature or mature ticks will have died off.

Treatment of the environment

In human or animal habitations ticks can be attacked, and a high proportion killed, by thorough applications of DDT or one of the other chlorinated hydrocarbon compounds. The Expert Committee of the World Health Organisation on Vector Control (1948) reported, for example, that the soft tick, *Ornithodoros moubata*, was successfully controlled in British Somaliland by applications of BHC to the floors and lower two inches of the interior walls. BHC has also been successfully used against this tick in South Africa and Rhodesia.

Control of ticks in the soil and vegetation of open country is rather a different problem, but the WHO Committee mentioned above reported that it can be achieved by spraying or dusting the land with DDT, chlordane, dieldrin or toxaphene either from aeroplanes, helicopters or by other means. Parathion has also given good control. The nature of the land will naturally influence the amounts and formulation of the acaricides used. This kind of treatment may be expected to prevent re-infestation with the ticks for 30 days or longer. Control of the hard tick *Dermacentor variabilis*, which congregates along tracks and roads where it has good opportunities for getting on to its mammalian hosts, can be obtained by applying the acaricide to strips of land on each side of the tracks and roads. DDT and BHC are also effective against the soft tick of birds, *Argas persicus*, in poultry houses.

Another line of attack on stages of ticks off their hosts takes advantage of the fact that ticks, although they can live for long periods without a meal of blood, are dependent on certain degrees of moisture and temperature and too much light disturbs them. Agricultural treatment of the land which will open up the shelter they seek and expose them to climatic influences will therefore help to kill them off. Such measures include burning off pasture plants, breaking up dense mats of vegetation, drainage to reduce moisture, ploughing and re-seeding. Measures of this kind are, however, applicable only to restricted areas.

Among protective measures which man can adopt are the wearing of protective clothing and the use of repellents. Among the latter dibutyl adipate, hexyl mandelate and *n*-butyl-acetanilide have been recommended. Because some species of ticks may cause tick paralysis, the results of which may be fatal if the ticks are not removed at once, methods of removing ticks may be important. It is, however, very difficult to persuade a tick to let go its hold until it is fully engorged with blood. From animals ticks can be scraped or curried away, but the false head is then broken off and left in the skin, possibly to give rise to sores. The application of chloroform, acaricides, alcohol and even the lighted end of a cigarette have all been tried, but none of them seem to be really effective; they may merely burst the tick and lead to the development of sores around the mouth parts of the tick left in the skin.

Control of mites

The principles governing the control of mites are in general similar to those governing the control of ticks but allowance must be made for differences in the life histories of the species concerned.

Dermanyssus gallinae:—The nests of infested birds should be removed and burnt and well-made poultry houses should be provided which are free from cracks and crevices in which the mites may shelter. Good results are obtained by treatment of the quarters of the birds with malathion or lindane but technical grades of gamma BHC must not be applied to birds or to their food. Crates in which the birds have been temporarily removed while their quarters are being treated should be sterilised with boiling water or with the remedies just mentioned. It should be remembered that this mite can live off the host for 4 to 5 months without feeding on blood. Good control has been reported by the application, repeated after 2 to 3 weeks, of the carbamate compound 'Sevin', to the poultry houses, deep litter and perches. It did not taint the eggs or affect egg production. Treatment should begin in the spring, before heavy infestations build up. For the protection of man benzyl benzoate, benzocaine and emulsified DDT have been found useful.

Ornithonyssus:—Control of species of this genus may be difficult, because, although they spend most of their lives on the birds, they may also be found in nests, the fabric of the poultry houses, fittings etc. The Northern Fowl Mite, *O.sylviarum*, is not controlled by lindane and, although nicotine will kill it, it is an inconvenient and dangerous acaricide. Malathion however, is highly efficient against this mite as well as other poultry pests and is safe to use in poultry houses and on the birds themselves. Houses should be sprayed with 0.75% emulsion or suspension, or a 4% malathion dust should be applied to the floor space and litter at a rate of 1lb. per 50 to 60 sq. ft. Birds should be dusted with 4% malathion, treatment being repeated as necessary. It is reported that some of the new organo-phosphorous compounds such as coumaphos, fenchlorphos, trithion and Dibrom will effectively control this species, but, when cost and safety are taken into account it is as yet doubtful whether they are better. It has also claimed that the administration of Sevin in the mash frees the birds of this species. Similar methods may be used for the control of *O. bursa*.

In the control of *O. bacoti* for the protection of man, the spraying of houses with DDT, Lindane or chlordane is recommended. However, it must be remembered that control of *O. bacoti* is carried out for two main reasons, (a) it is responsible for the transmission of human Rickettsial pox in America and, (b) it transmits endemic (murine) typhus from rat to rat, thus maintaining a reservoir of infection from which man can be infected. Where, therefore, endemic typhus is prevalent, remedial measures also involve the control of *O. bacoti* on its rat hosts, and it is stated that the application of DDT, with or without sulphur, to the rat runs will reduce the number of mites on the rats. The control of rats frequently plays an essential role in anti-typhus control, but, before this is carried out, measures must be undertaken for the control of *O. bacoti* and the fleas transmitting endemic typhus from rats to man, so that when the rats are eradicated there will not be large numbers of typhus infected vectors transferring their whole attentions to the secondary host, man.

Trombiculid larvae:—Control of the effects of these depends largely on trying to prevent the larvae from reaching their hosts. Spraying of buildings or vegetation with acaricides will prevent many larvae from hatching out in these situations. Grass and other vegetation should first be cut and opened out and chlordane, dieldrin or lindane can then be applied either as dusts or sprays. DDT is not sufficiently effective. To protect man repellents may be used, during the second World War, for instance, troops were well protected by regular application of benzyl benzoate to the clothing, especially at the wrists, ankles and other places through which the larvae may gain access to the skin and to the underclothing. Garments may also be impregnated with the repellent. Some mosquito repellents such as diethyl toluamide are effective, but benzyl benzoate has the advantage that it will withstand two washes of the clothes. Unfortunately methods of this kind cannot be employed with dogs or other domesticated animals, which may suffer greatly from the bites of these larvae on their feet and legs.

Demodex folliculorum:—Control is difficult, because the mites live in the hair follicles and it is difficult to bring acaricides into effective contact with them. Fiedler and Du Toit have, however, found that the *delta* isomer of BHC is effective against them and will cure even

advanced cases of demodectic mange. Well aired and sanitary quarters, which are not overcrowded, will help to prevent infection of healthy dogs by contact with infected ones. An adequate, well balanced diet also helps.

Human scabies:—Since ancient times sulphur has been used to kill *Sarcoptes scabiei* of man, either as baths containing it similar to those used by the Romans, or as ointments. A usual method nowadays is to give the patient a hot bath and, after drying, to anoint the *whole* body with Ung. Sulphuris B.P., half the strength being used for children. This is repeated without a bath on the two following nights. The patient's bedding and clothing must also be disinfected. It has been claimed that this method will cure 100% of the patients, provided that it is properly done. Ung. Potassii Polysulphidi B.P. also been used. Sulphur, however, has an unpleasant smell and may cause dermatitis. Benzyl benzoate is also effective and is less objectionable. Other remedies that have been recommended are tetraethylthiuram monosulphide, either in watery solution or in the form of "Tetmosol" soap, and lindane, applied as an ointment, cream or emulsion.

Sarcoptic mange:—For the treatment of sarcoptic mange of sheep and cattle gamma BHC, dieldrin and toxaphene may be used as dips, sprays, washes or creams, but toxaphene, chlordane and dieldrin should not be used on dogs, cats or poultry. It should also be remembered that BHC, although it is not usually poisonous at the strengths recommended for treatment, may be toxic to cats, turkey poults, calves younger than three months and older cattle in poor condition. Lindane and malathion have been recommended for the treatment of dogs and swine.

Cnemidocoptes:—BHC has been found to be an effective remedy for infection with *Cnemidocoptes mutans*. For *C. gallinae* a mixture of sulphur and sodium fluoride has been recommended and DDT may be useful.

Notoedres:—Tetraethylthiuram monosulphide ("Tetmosol", "Mitigal") has been effective for the protection of cats against infection with species of this genus. BHC and other related compounds have been tried, but these chlorinated hydrocarbons may be toxic to cats infected with *N. cati* and for these animals malathion has been found to be the safest and most effective remedy. Cats confined in open weave bags may be immersed in a watery suspension of malathion for 1 to 2 seconds, this form of dipping being repeated a week or so later.

Psoroptic mange (Sheep scab)

Psoroptes:—This mite is successfully controlled by dips containing BHC. No case of sheep scab has been reported in Great Britain since 1952 and, as was explained in part II of these articles, the disease has been eradicated twice from Australia and its eradication from the United States is only a matter of time.

In South Africa it has been found that dieldrin will also eradicate this mite. An advantage of this acaricide is that it diffuses better along the wool fibres of sheep than other chlorinated hydrocarbon acaricides and so more readily reaches the skin where the mites are situated. Whenever the disease is treated care must be taken that adequate application is made to the ears, groin and the region below the eyes where the mites may escape the action of acaricides in dips and thus form a nucleus of infection for fresh outbreaks of the disease. Treatment of other animals should follow the same lines.

Chorioptes:—In Canada Sweatman tested 39 acaricides, including 10 organo-phosphorous compounds, against *C. bovis* of cattle and found that the most effective were lindane, dieldrin, trithion, Thiodan and fenchlorphos, in that order. The residual effect of lindane lasted for 9 days, which was long enough to kill larvae emerging from eggs not killed by the acaricide. Lindane has been accepted in Canada for the routine treatment of chorioptic mange of cattle and horses. An older method of treating horses was to bathe their feet in lime-sulphur dip after clipping the hair round the lesions.

Otodectes:—This mite, found in the ears of the dog, cat and other small mammals, may be controlled by cleaning out wax and crusts formed over the lesions and applying rotenone in a light mineral oil or chlordane or lindane in oil.

Conclusion

With these brief notes we must conclude this series of articles, in the course of which much detail has necessarily been left out But enough has probably been said to indicate the main principles governing diseases caused by ticks and mites and the methods used for their control. No doubt the discovery of acaricides more effective than those mentioned above will eventually give us even better control than that which has so far been attained.

EDITOR'S NOTE

To save confusion, common names have been used as far as possible in this article, however, as various synonyms have been used in scientific literature the following list of alternative names may be of assistance.

(1) coumaphos, [0,0-diethyl 0-3-chloro-4-methyl-7-coumarinyl phosphorothioate] = Asuntol, Co-Ral, Muscotox and Bayer 21/199.
(2) fenchlorphos, [0,0-dimethyl, 0-2,4,5-trichlorophenyl phosphorothioate]=ronnel (U.S. common name), Etrolene, Trolene, Korlan, Nankor, Viosene, Dow ET. 14 and Dow ET. 57.
(3) dioxathion, [2,3-p-dioxanedithiol-S, S-bis (0,0-diethyl phosphorodithioate)] = Navadel, Delnav.
(4) 'Sevin' = l-naphthyl-N-methyl carbamate.
(5) trithion = 0,0-diethyl-S-p-chlorophenylthiomethyl phosphorodithioate.
(6) Dibrom = 0,0-dimethyl-0-(1,2-dibromo-2,2-dichloroethyl) phosphorate.
(7) Thiodan = 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepine-3-oxide.
(8) lindane, refers to a product of specified purity containing a minimum of 99% of the *gamma* isomer of BHC.

PERSISTENCE OF KHAPRA BEETLE IN SHIPS' HOLDS

By E. T. HURLOCK,* B.Sc.

The Khapra beetle is one of the most serious stored products pests not only because of the damage it causes to grain, pulses and other products but also because of its ability to survive both fumigation and treatment with insecticides.

In the following account the author cites several outstanding examples in order to draw attention to the remarkable persistence of this pest.

IT is well known that the Khapra beetle, *Trogoderma granarium*, (plates 1 & 2) is one of the most serious pests of grain, pulses, oilseeds and oilcake, both because of the very considerable damage that it can cause and also because it is resistant to many insecticides and fumigants. Strict quarantine measures are imposed by Canada, U.S.A., East and South Africa. When it is present in the structure of cargo vessels it is especially serious because of the danger of infestation of cargo. Many vessels in international trade are known to be harbouring it even after several attempts at eradication. The persistance of this insect is especially noticeable in the after holds where heat from the engine room and the propeller shaft tunnel provide the high temperatures necessary for breeding.

During the course of their work of inspecting imported food cargoes for insect infestation, Inspectors of this Ministry and of the corresponding Department in Scotland found that between 1957 and 1959, 138 ships were infested by *Trogoderma*. Many of these ships have harboured the insect for a number of years despite repeated insecticidal treatments. Others, particularly those in the S.E. Asian and W. African trade are subject to frequent reinfestation from infested commodities stowed in them. The principal offenders in this respect are oilseeds and oilcakes, which if they are intended for the animal feeding stuffs market or for oil production, tend to be exported from the producer country unfumigated. Produce from Burma, India, Pakistan, Iraq, Cyprus, North and West Africa is particularly liable to be infested with this insect.

Examples

The following examples are some of the more outstanding cases that have been investigated by Inspectors of the Ministry in recent years. They serve to illustrate how infestations of *Trogoderma* can persist for a long time and present a potential danger of infestation of cargoes of all types including grain.

Case 1 (1955-1958):—For five years from November, 1950, when it was first inspected, to October, 1955 this vessel had apparently not carried a *Trogoderma* infested cargo and had been free from any residual population of *Trogoderma*. This was in spite of regular voyages to and from India.

However in October, 1955 during an inspection in London, living *Trogoderma* larvae were found in a consignment of peas stowed in No. 4 lower hold. The ship then proceeded to Glasgow where Inspectors discovered that linseed cake and groundnut cake in No. 1 lower hold were also infested by this insect. The use of gamma—BHC smoke generators to kill any insects that may have fallen off the cargo was recommended.

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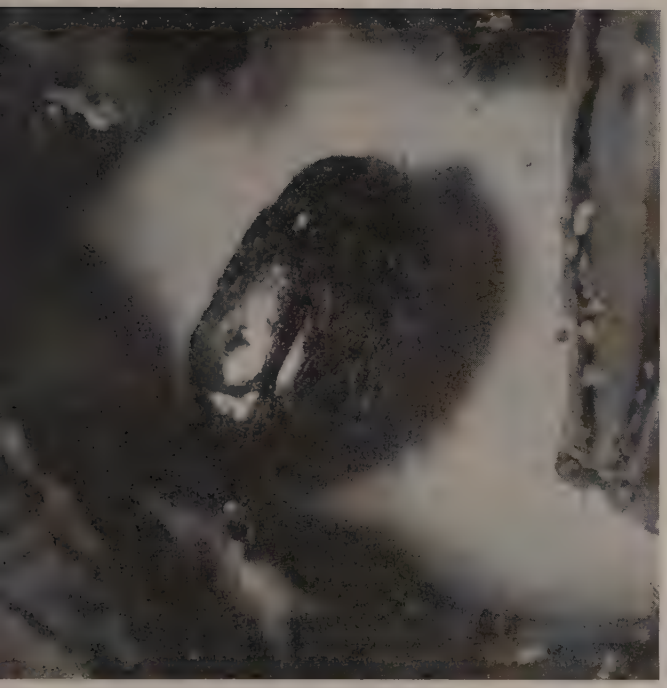

Adult Khapra beetle, *Trogoderma granarium.*

Larva of *Trogoderma granarium.* Crown Copyright Photos

In March and April, 1957 in Liverpool the vessel was again inspected after a voyage to India. Large numbers of larvae were found in No. 1 'tween deck after the discharge of oilcake. This cargo space was sprayed with gamma—BHC and the entire hold was then treated with the same insecticide in the form of a smoke. After proceeding to Glasgow a further inspection was carried out and it was found that, due in part to insufficient cleaning, large numbers of larvae had survived the treatment and were still alive.

In July of the same year after yet another voyage to India large numbers of larvae were found by Inspectors in Liverpool to be still present in No. 1 'tween deck. Thick clusters of larvae were present beneath residues, beneath flaking paintwork and in other crevices. After discharge in Glasgow was complete a further inspection confirmed the Liverpool report. Larvae were even present where dust had accumulated on the top of rivet-heads. Very thorough cleaning of all the crevices with a stiff brush was done followed by fumigation with methyl bromide at a dosage of 32ozs per 1,000 cu. ft. for an exposure period of 24 hours. At a post-fumigation inspection it was found that cleaning had been well carried out. Gas measurements made at the time showed that an adequate concentration of gas had been maintained in the free space but it is not certain that a similar concentration was achieved actually inside the crevices that were harbouring the insects. As the chemist who was present said later "where the space under the flakes was tapered, small larvae were packed in at the extreme end with progressively larger ones behind them, with the result that to get at the small ones at the furthest points of the flakes, the gas would have to penetrate through an inch or more of virtually solid *T. granarium* larvae".

Probably for this reason the fumigation was not a complete success and in January 1958, in London, a few live larvae were still present in No. 1 'tween deck. It was thought that these were probably survivals and not reintroductions. As usual the vessel proceeded to Glasgow for final discharge where the affected hold was sprayed with malathion. Unfortunately it had not been thoroughly cleaned prior to treatment and again a number of surviving larvae were found in cracks and crevices.

When the ship returned to the United Kingdom in May 1958, it was again inspected in Liverpool, Avonmouth and Glasgow and a very few live larvae were found. Insecticide smoke treatment (BHC) following thorough cleaning was carried out, on this occasion with apparently good results because, in two inspections in 1959 and another in 1960 no *Trogoderma* larvae were found.

Case 2 (1952-1959):—During 1959 a cargo of 240 motor cars carried in this vessel from France to Houston, Texas became infested by larvae of *Trogoderma granarium.* It cannot be said that the insects were likely to damage the cars but the application of the strict

quarantine rules governing the importation of the insect into the U.S.A. meant that fumigation of both the cars and the ship had to be carried out.

From a study of the previous history of the vessel it appears that grain residues (uninfested at the time) remained in the holds after a cargo of wheat was discharged in 1952. During subsequent voyages from West Africa between 1953 and 1956 these residues became infested by *Trogoderma granarium*. In 1958 an inspection revealed traces of *Trogoderma* (cast larval skins, etc.) associated with the wooden casing of a water tank in No. 3 shelter deck. Spraying with malathion insecticide was carried out. However insects were again found in 1959, and it appears that the spraying was not fully effective although an alternative explanation is that the pest was reintroduced to the vessel during the early part of 1959. According to the reported movements of the vessel it is possible that the holds became reinfested from a Middle or Near-East cargo at about that time.

No *Trogoderma* have been found on the vessel since the treatment carried out in the U.S.A.

Case 3. (1954-1956):—An endemic infestation of *Trogoderma granarium*, believed to have been present since late in 1954, gave rise to an infestation of Canadian wheat carried in March, 1956. The insect was probably introduced into the vessel with a cargo of wheat and wheat offals carried in No. 4 hold from the eastern Mediterranean region in December, 1954. Cottonseed cake was also present in the same hold but it is unlikely that this was the source of the trouble.

After this voyage the vessel made two more trips to the Mediterranean, two to northern Russia and one to Spain before proceeding to St. John, N.B. to load Canadian wheat for the United Kingdom. When this wheat was inspected whilst being discharged in this country part of the bulk was found to be moderately infested. The infestation was centred on the timber lining to the engine room bulkhead of No. 4 lower hold behind which residues of grain had accumulated and had become infested and where conditions were warm enough to enable *Trogoderma* to breed. Following this discovery the United States and Canadian authorities were notified and the ship was successfully fumigated with hydrogen cyanide before loading a further cargo of grain at Albany, N.Y.

Case 4. (1956-1960):—Any one of a number of cargoes of west African produce carried before 1956 may have been responsible for the introduction of *T. granarium* to this ship. When discovered in April, 1959 the endemic infestation had reached significant proportions and was centred, as in case 3, on the insulation lining the engine-room bulkhead of No. 4 lower hold, and on the mid-line bulkhead over the propellor-shaft tunnel. Part of the cargo of South African White Dent Maize in this hold had become infested. The heat from the engine room had enabled the *Trogoderma* to breed and the temperature of the grain near this bulkhead was 90°F. These conditions had stimulated larvae to leave their hiding places in the bulkhead and its insulation and to migrate into the cargo in search of fresh food material.

As soon as the infestation was discovered and discharge completed the hold was fumigated with methyl bromide (36oz/1,000 cu. ft. for 12 hours). However this was not successful as was at first thought because at a later inspection in mid-1960 living *Trogoderma* were still present in the hold. Spraying with 1.5% malathion water dispersible powder was recommended on this latter occasion.

It appears that after its introduction into the vessel prior to 1956 the infestation survived three fumigations with hydrogen cyanide, given against other insects, in addition to the methyl bromide fumigation noted above. Two of these hydrogen cyanide fumigations were given at a dosage of 9 oz./1,000 cu. ft. for 9 hours which whilst being adequate to kill *Trogoderma* in warm conditions is unlikely to kill at the temperatures prevailing in the United Kingdom: the third was carried out in Vancouver and details of it are not known.

Control measures

These examples show that, because of the persistence of *Trogoderma* in those parts of a ship where local heating provides conditions suitable for breeding, rigorous control measures are necessary whenever *Trogoderma* is found to be present.

When a properly conducted fumigation can be carried out, methyl bromide, because of its ability to penetrate cracks and crevices quickly, is propably the best chemical to use. Unfortunately it has been shown that except at high temperatures the larvae of *Trogoderma* are resistant to this gas. Non-feeding larvae established in crevices, are particularly resistant to it. However in those cases where time does not permit of complete fumigation the liberal application of a spray containing malathion, which has been found to be particularly effective against *Trogoderma*, may provide a good measure of control. A suitable spray may be obtained by mixing either eight ounces of a 30% or ten ounces of a 25% malathion water dispersible powder to one gallon of water and applying it to 1,000 sq. ft. of surface. Special attention should be given to cracks and crevices, and to the removal of residues before treatment commences. The spray is most readily applied by using a motorised knapsack sprayer.

ACKNOWLEDGEMENT

The inspections from which the examples are drawn were carried out by the Inspectors of the Infestation Control organisations of the Ministry of Agriculture, Fisheries and Food and the Department of Agriculture and Fisheries for Scotland.

NEWS AND NOTES

New Use for Propham

Under the heading "Clamp Jabs Stop Potatoes Sprouting" the *Farming World*, February 2nd, 1961, reports that G. & S. G. Neal Ltd., Holbeach, are carrying out trials with propham as a sprouting inhibitor in potato clamps and stores.

Using a special injector, propham powder is forced into the clamp or store by means of high air pressure. The injections are made into the clamp at the bottom, middle and top at 1yd. intervals. The potatoes should have been in the clamp long enough to allow them to sweat out.

It is stated that this technique for preventing stored potatoes sprouting, has been widely used in the Netherlands, France and Belgium and that, used in this manner, propham does not damage the potatoes or affect the skin colour, also it leaves no smell.

W.H.O. Malaria Campaign Headquarters for Salisbury

In a report from the Federation of Rhodesia and Nyasaland it is stated that the headquarters of a campaign organised by the World Health Organisation to wipe out malaria in South-East Africa is to be set up in Salisbury. The new co-ordinating board will have a permanent secretary, Dr. Otto Mastbaum, and will cover Swaziland, parts of South Africa, and Mocambique; and the South of Southern Rhodesia and Bechuanaland. This was announced in Salisbury on January 26, following a two-day meeting of a board set up under the world Health Organisation to examine the problem. An official of the Organisation, Mr. Max Wilde, said that of the 120,000 African migrants who moved in and out of the new headquarters' area in the course of a year, about 30 per cent. were infected with malaria.

At the opening of the conference on January 25, the Rhodesian Federal Minister of Health, Mr. B. D. Goldberg, said that in many areas in Africa, men, women and especially children, will die from malaria and starvation because of the actions of self-seeking, unprincipled so-called "Leaders". Mr. Goldberg said these "Leaders" were quite prepared to expose the masses of the people, in the most callous and heartless manner, to the ravages of disease. Like the Congo, the health of people in Nyasaland had suffered because of political unrest, he said. Useful preliminary work in malaria control had been seriously prejudiced in a heavily populated part of Nyasaland because of this unrest.

Take Over

The firm of Roland C. Heath Ltd, 33 Winchester Road, London, N.W.3 has now purchased all the stocks originally held by H. E. Helman (Insecticides) Ltd., and the Company trading under the name of Helman Chemicals. The products of Helman (Insecticides) Ltd., will still be marketed under their trade names, but will be manufactured and distributed in the future by this organisation. In addition a number of new products will be introduced.

The Directors of the new Company are, Roland C. Heath and Edna H. Caswell who will be supported by an advisory team of chemical and veterinary experts.

Post-graduate Studentships

The Ministry of Agriculture, Fisheries and Food and the Department of Agriculture and Fisheries for Scotland propose to award for the academic year beginning 1st October, 1961, a limited number of post-graduate studentships in the various branches of husbandry (including horticulture), farm management, agricultural or horticultural economics, (including rural estate management), agricultural or horticultural statistcs, agricultural engineering (including dairy engineering and farm mechanization) and agricultural science.

Post-graduate awards are also offered by the Agricultural Research Council, Cunard Building, 15, Regent Street, London, S.W.1., for training in research. These are open to graduates in science, and graduates in agriculture or horticulture who have shown a special interest in one of the basic sciences. Applications for awards in veterinary science should be made to the Agricultural Research Council.

The number of awards offered by the Ministry was increased in 1958 so that it is no longer necessary for the Ministry of Education to extend State Scolarships or to supplement College and University awards for post-graduate study in agricultural subjects, nor for Local Education Authorities to make awards.

Applicants normally resident in England, Wales and Northern Ireland can obtain further particulars and forms of application from the Ministry of Agriculture, Fisheries and Food, Room 215A, Great Westminster House, Horseferry Rd., London, S.W.1. Applicants normally resident in Scotland should apply to the Department of Agriculture and Fisheries for Scotland, Room 53, St. Andrew's House, Edinburgh 1

The closing date for receipt of completed application forms is 31st March, 1961.

Awards are also available to post-graduate and post-doctoral students of agricultural science under the NATO Science Studentships and Fellowship Programme, which is intended to stimulate the exchange of students between member countries in the North Atlantic Treaty Organisation. The scheme is administered for U.K. students by D.S.I.R., Charles House, 5-11, Regent Street, London, S.W.1., to whom applications should be made.

Tanganyika to Support Desert Locust Control

The Minister for Agriculture and Co-operative Development, Mr. Paul Bomani, said at a recent meeting of the Desert Locust Council in Nairobi that Tanganyika recognises the importance of an international organisation to control desert locusts.

The Minister said that he was prepared to support a contribution from Tanganyika to the Desert Locust Survey and Control Organisations for the 1961-62 season at the same level as the 1960-61 contribution, on the strict understanding that other countries did likewise.

Future payments would be made depending on any changes in Tanganyika's financial position and Government policy.

K.E.F. Managing Director Retires

Mr. Leonard C. Pearch, managing director of Kent Engineering and Foundry Limited, Maidstone, has retired from the company which he formed in 1941. The new managing director is his son, Mr. Robert L. Pearch, who joined the board of directors in 1947.

Mr. Pearch senior has also retired from the boards of two associate companies which will continue under the direction of his son: Minok Engineering Co. Ltd., distributors of Solo engines and power saws; and K.E.F. (Engineers) Ltd., agricultural machinery distributors.

Mr. Leonard Pearch, who is 64, has devoted the whole of his working life to agricultural engineering, except for the first World War period when he was in the Royal Naval Air Service and concerned with airship construction. After 31 years service with W. Weekes & Sons Ltd., Maidstone, progressing from apprentice to chief designer, Mr. Pearch resigned to become managing director of a small works at Tovil, Maidstone, known as the Kent Brass Foundry Ltd. It was from this that he built the present K.E.F. Ltd. Under his guidance K.E.F. pioneered the development of tractor drawn and tractor powered fruit spraying equipment and also became leaders in the introduction of hop picking machinery.

Mr. Pearch, who was president of the Agricultural Engineers Association in 1959-60, also played a leading part in the establishment of the Colonial Spraying Centre at Silwood Park, Sunninghill, Berks.

Spraying Service for African Farmers

A campaign aimed at increasing African agricultural productivity and community development has been started at Ukutu, in the Morogoro District, of Tanganyika by the Agriculture and Social Development Divisions which have formed a Development Team in co-operation with the Native Authority.

The Agriculture Division is to instruct African peasant farmers in modern farming methods and initiate the formation of a growers' association to provide spraying services and insecticides to members. The Social Development Division will help with audio-visual aids to show how cash crops can best be grown.

It is also reported from Tanganyika that the demand for insecticides is on the increase particularly for powders for the protection of stored grain.

Amended Regulations For Warble Dressings

Ready made derris preparations, as an alternative to powdered derris diluted with water, may now be used for the compulsory dressing of cattle infested with warble fly. Dressing is required to take place each year during the period 15th March to 30th June.

Compulsory dressing will, in future apply to cattle where the warble fly maggot is discernable by touch (e.g. in long-haired beasts) as well as to those visibily infested. These changes in the regulations have the support of the National Farmers' Union.

The Ministry is continuing to follow with great interest the development taking place with systemic insecticides. These insecticides are designed to kill the maggots in the animal's body before they reach and puncture the hide. When there has been more experience of these substances, the present policy of compulsory dressing will be re-examined.

N.A.A.S. Appointments

Mr. W. R. Smith, B.Sc., N.D.A., at present Livestock Husbandry Officer for Wales, has been promoted Deputy Regional Director in the Yorks. and Lancs. Region in succession to Mr. T. C. Creyke who has taken a post with the International Bank.

Mr. W. S. Rayfield, N.D.A., at present County Advisory Officer for Yorkshire, (North Riding), has been promoted to Deputy Regional Director and will take up the post of Assistant to the Senior Advisory Officer (Agriculture) in London in succession to Mr. R. B. Ferro, N.D.A., who was appointed Regional Director, East Midland Region on 1st December, 1960.

Mr. P. H. Brown, N.D.H., at present Director of Efford Experimental Horticulture Station, Lymington, Hampshire has been promoted Deputy Regional Director and will take the post in the East Midland Region vacated by Mr. N. F. McCann, B.Sc., N.D.A. who is succeeding Mr. J. W. Reid, O.B.E., N.D.A., F.A.C. (Glas.) as Regional Director, Yorks. and Lancs. Region on 1st March, 1961, when Mr. J. W. Reid becomes Senior Advisory Officer (Agriculture) at Headquarters.

Mr. Colin D. Ross, O.B.E., B.Sc., Regional Director of the National Agricultural Advisory Service, South Western Region since October 1946, will be retiring from the public service on 9th March, 1961 He will be succeeded on 1st May, 1961 by Mr. E. L. Harry, O.B.E., M.Sc., at present Regional Controller of the Ministry's East Midland Region.

More Woodworm Insurance

In association with Crusader Insurance Co. Ltd., Woodworm Insurance Company Ltd., a newly formed member of the Rentokil Group are to operate the second woodworm insurance scheme to be launched in Britain. (see *Pest Technology*, December 1960 p. 79 for details of 1st scheme). However, it is the first insurance scheme against woodworm which covers the whole of great Britain because, being a member of the Rentokil Group, the Woodworm Insurance Co. operates from any of the national network of offices in the Group eg. Woodworm and Dry Rot Control Ltd., Disinfestation Ltd., and it is also the first scheme in which the policy covers all accessible structural timbers as well as roofs. In addition it is the first scheme in which other buildings such as warehouses, barns etc. as well as dwelling houses can be insured.

Initially a survey is carried out free of charge and obligation. Should the property be free of woodworm, immediate cover can be obtained. However, if the survey reveals signs of woodworm attack treatment of the infested areas must be carried out before the property can be insured, the owner must pay for this treatment. This treatment, of course, may be of only a limited part of the structure whereas the policy will cover the entire building excluding furniture, posts, garden sheds and other temporary buildings. Moreover, if the treatment of infested areas is carried out by an approved specialist company a discount of up to 25% can be allowed on the annual premium. It is believed that approved specialist companies include not only Woodworm and Dry Rot Control Ltd., but also any member of the British Wood Preserving Association.

Subject to a minimum premium of £2-10-0 per annum the rates are based on the following:-

Property up to 10 years old–
1/3 per £100 of fire insurance or market value.

Property up to 30 years old–
1/6 per £100 of fire insurance or market value.

Property over 30 years old–
1/3 per £100 of fire insurance or market value.

The Policy is an annual one and may be assigned to the new owner should the property change hands. Subject to the payment of the annual premiums the policy binds the Woodworm Insurance Company to the agreement for a period of five years following its instigation, although the house owner may terminate the agreement at any time within this period.

The cost of insurance may be included in the Repairs Allowance for Schedule "A" income tax purposes.

Further information is obtainable from Woodworm Insurance Co. Ltd. 16, Dover Street, London, W.1. or any branch office of Woodworm and Dry Rot Control Ltd.

Minister Speaks on Approved Agricultural Chemicals

The Joint Parliamentary Secretary to the Ministry of Agriculture, Fisheries and Food, Mr. W. M. F. Vane, T.D., M.P., presided at a London press conference held on 1st February to announce the publication of the first List of Approved Products under the Agricultural Chemicals Approval Scheme.

Mr. Vane said:- "The purpose of today's Conference is to tell you something about the new Agricultural Chemicals Approval Scheme.

"This is a joint venture. It cannot be a success unless manufacturers submit their products for approval, if the merchants do not sell approved products and if the farmers do not buy them. I am therefore glad to have the support this afternoon of Mr. Mellor, the Chairman of the Association of British Manufacturers of Agricultural Chemicals, of Mr. Bradford of the National Association of Corn and Agricultural Merchants and of Mr. Limb of the National Farmers' Union. I would also like to introduce Mr. Moore, the Director of the Ministry's Plant Pathology Laboratory and also the Director of the Agricultural Chemicals Approval Organisation which runs the Scheme.

"Today, the first list of products approved under the new Scheme is being published. The Scheme replaces the 20 year old Crop Protection Products Approval Scheme, and has some big advantages over it.

"The old Scheme was never as widely known as deserved and use of chemicals remained something of a mystery to too many people. We must clear up this mystery. There is nothing sinister. The most important feature is that it should be possible to grant approval to a new chemical by the time it is ready for marketing. Farmers will now be able to choose Approved Products from among the very newest agricultural chemicals.

"But this calls for close co-operation between the agricultural chemical manufacturers and the Approval Organisation. I am pleased to say that the manufacturers' co-operation is assured. We are indebted to their Association for all the help they gave us in drawing up the new Scheme, which now covers the United Kingdom, the Channel Islands and the Isle of Man.

"When a manufacturer is planning his field trial programme to assess the efficiency of his new product, he will inform the Approval Organisation, in confidence, of the chemical composition of his product, the work he has so far done on it, and of the trial programme he intends to carry out. The organisation will advise him whether the proposed programme is satisfactory. If the organisation wishes to have independent evidence as well, it will arrange for independent field trials to be carried out—another important new feature of the Scheme. They will be carried out by the Government's Advisory Services. Then the Organisation will consider all the evidence and decide whether or not approval can be granted. No product will be approved until the Organisation is quite sure that it will do the job it is intended for properly. The claims made for products previously approved under the old Scheme were thoroughly reassessed before the products were re-registered in the new Scheme.

"Once approval has been granted, no change can be made to the claims included on the label of an Approved Product without the permission of the Approval Organisation. Any applications to make such a change must be supported by evidence that the product really can do what is claimed for it. It is important to follow instructions on labels exactly. In no case use a double dose just to be on safe side. You never do good. You often do harm.

"The Approval Scheme is not directly concerned with the safety requirements for agricultural chemicals, but approval cannot be given to a product containing a toxic chemical unless its safety in use has first been considered and cleared under the voluntary notification scheme, and recommendations about any precautions considered necessary have been made.

"This is a most important safeguard, as the notification scheme is concerned with the risks which may arise from the use of toxic chemicals to operators, to consumers, to animals, bees and wild life, and to the general public. The substance of any such recommendations is included on the labels of toxic chemicals approved under the Agricultural Chemicals Approval Scheme and the List of Approved Products also mentions them. The 1961 List of Approved Products contains the names of about 400 products approved since the Scheme came into operation in June, Details of further approvals will be published in the Ministry's journal 'Agriculture'. A complete list of approved products will be published annually every February.

"I am confident that this new Scheme will not only be a most valuable guide to users of agricultural chemicals but will also discourage the use of unsatisfactory or inefficient products. I hope that before long it will become automatic to look for the new Approval Mark on the can before buying a chemical—and that this Mark will become familiar to everyone as a trusted sign of reliability. The interested organisations and the allotment holders and gardeners' societies, have all promised their support and I hope the time will soon come when only Approved Agricultural Chemical products will be offered for sale.

"I would close then by exhorting manufacturers to try and get all their products approved; merchants to sell only approved products; and users to buy only agricultural chemicals bearing the Approval Mark on their label."

Symposium on Fungicides

The Pesticides group of the Society of Chemical Industry have arranged a symposium on Fungicides in Agriculture and Horticulture to be held on 20th and 21st March 1961 at the Society's Rooms at 14, Belgrave Sq., London, S.W.1. (If a large number of applications are received larger accommodation will be sought and delegates will be informed of the final venue). Charges will be £1 for S.C.I. members and £2 10 0 for non-members.

The four sessions of the programme are:—

Monday morning: Current Usage and Recent Developments.

Monday afternoon: Theoretical Bases for Fungicides.

Tuesday morning: New Developments in Organic Fungicides; Structure/Activity Correlationships.

Tuesday afternoon: Antifungal compounds in seedling of *Vicia faba;* "Allisan," "Melprex".

Application forms and full details are obtainable from Dr. B. J. Heywood, 103 Harrow Drive, Hornchurch, Essex.

Modern Mixing

The Waring Products Corporation, a subsidiary of the Dynamics Corporation of America, have developed a Commercial blendor, Model CB-4, which is marketed in the United Kingdom by the Waring Division of Winston Electronics Ltd., Shepperton, Middlesex, after finding that the domestic Waring Blendor was being used in laboratories.

The Model CB-4 is claimed to be the only commercial blendor of its type on the market to-day. It is manufactured, especially for use in catering of all kinds such as restaurants, hospital and institutional kitchens and canteens, but in industry too it has many uses in the laboratory and in the factory. The industries finding the Commercial Blendor to be useful include: Paint, Plastics, Paper, Pulp, and Pesticides etc.

The CB-4 will also mix, homogenize and emulsify viscous ingredients over long periods with cool motor running. The simple methods of cleaning and the avoidance of material-collecting spots in the construction of the one-gallon container ensures chemical cleanliness. The one-gallon capacity model will mix or blend any quantity from one to eight pints.

The container is of stainless steel as are the mixing blades which can be set to run at 14,000 r.p.m. 17,000 or 19,000 r.p.m. as required. There is a two piece clamp-on splash cover, with sealing gasket, and cover for sampling and adding further ingredients. The overall height is 23 inches and weight is 36 lbs. It is electrically driven by a 250V, 50 cycles single phase AC, 15 amp motor.

The Commercial Blendor Model CB-4 is approved by the American Underwriters Laboratories and the Canadian Standards Association.

Import Of Raw Vegetables

From the 1st March the importation into England and Wales of certain raw vegetables (excluding potatoes) from parts of Belguim, France, Italy and the Netherlands will again be permitted, under modified conditions of entry, during specified periods of this year. Details are given in an Order, entitled the Importation of Raw Vegetables Order, 1961 (S.I. 1961 No. 20), which has been made under the Destructive Insects and Pests Acts, 1877 to 1927, obtainable from H.M. Stationery Office, York House, Kingsway, London, W.C.2. or from any bookseller, price 3d.

The specified periods have been calculated so as to permit import when Colorado beetles are least active in the areas concerned.

Technical bulletins and leaflets

Adelges Cooleyi. An Insect Pest of Douglas Fir and Sitka Spruce :— This seven page leaflet written by Myles Cooke, B.Sc., Ph.D., Forestry Commission, describes the life cycle and feeding habits, of the conifer pest *Adelges Cooleyi.* The species of conifer attacked, the damage caused and control measures are also mentioned in this illustrated leaflet which is available as Forestry Commission Leaflet No. 2 from H.M. Stationery Office, London, price 9d.

Supplex Sprinkling Hose and Modern Methods of Moss Control: Two single page information sheets available from F. W. Berk & Co., Ltd., Berk House, P.O. Box 500, Portman Square, London, W.1. and other branches.

The first leaflet describes 'Supplex' a specially designed finely perforated plastic hose used for watering gardens and greenhouses and available in various lengths. The second leaflet gives the recommended application rates and price of the company's moss killing preparations. A third Information Sheet concerning additions to the company's Supplex range is also available.

Hexaplus and Protoplus :— This four page information leaflet is available from Preservation Developments Ltd., 23, Sloane St., London, S.W.1. It describes the rates, methods and timing of applications of Hexaplus (active ingredient gamma-BHC) and Protoplus (active ingredients gamma-BHC and a chlorinated phenolic fungicide) which are used for protecting logs against attack by ambrosia and bark beetles.

The novel feature of these two products is the fact that both can be diluted with either water or oil.

Agricultural Crop Protection Chemicals: This 150 page book published by May & Baker, Dagenham Essex, gives details of the company's herbicides, insecticides and fungicides for farm use. It is a most comprehensive publication well illustrated with some excellent close-up photographs of the seedling stages of various weed species and a number of 'easy to understand' diagrams and charts. The reader is thus shown which problems may arise, how to recognise them, the M & B chemical to use, and how to apply it.

Control of the Colarado Potato Beetle in Canada. Publication 1071. C.D.A., a two page leaflet giving a description of the appearance, life history and habits of the Colarado beetle. Recommendations for control measures are given DDT, is the main chemical recommended though where resistant species occur thiodan, endrin, toxaphene, calcium arsenate or lead arsenate may be used. Available from Information Division, Canada Dept. of Agriculture, Ottowa, Ontario, Canada.

LETTERS TO THE EDITOR

The Editor, Pest Technology

Sir–Regarding the article "Knapsack Sprayers for Disinfesting Ships' Holds" (*Pest Technology*, November 1960 pages 32-35) the method of comparative testing of residues from smokes and liquid sprays by using filter papers is quite unrealistic. It greatly favours the liquid spray which is absorbed and retained. In practice it is applied to an impervious surface and, because of its low viscosity, will run down. Only a limited amount is retained and a lot is necessarily wasted by draining down to lower levels. The deposited liquid coating will be non-uniform, that is, minimum thickness at higher and maximum thickness at lower levels apart from other variations characteristic of spraying operations.

The figures quoted for the deposit vary widely from 19 to 401mgm. per sq. ft., showing the crude non-uniformity of the manual spraying. This is shown even with the fall-out on horizontal surfaces. It is probable that some areas will be missed altogether.

The use of filter papers prompts the sprayer that these are test areas and is an open invitation not to neglect them.

Deposits quoted for spraying are for selected areas. A fairer picture would have been obtained if results, other than those for verticle surfaces, had been quoted. Insects remain in innumberable cracks and crevices and these have a better general chance of being penetrated by particulate smokes than by spraying, as advocated, because this latter depends on accessibility and conscientiousness of the operator. Smokes automatically fill the entire space.

It is disputed that the sprayer gives a more effective deposit within the desired range for crawling insects than can be achieved by smoke generators. It is a fact that quite adequate deposits from smoke generators are given on horizontal surfaces and on those surfaces which subtend a horizontal plane and these deposits are uniform in concentration. Insects are not imobile and have only to contact the insecticide deposit wherever it may be. A uniform lethal dosage is present. The amount of uniform deposit is increased by simply increasing the number of smoke generators.

It is highly unlikely that efficient and thorough spraying of a hold could be effected in the short times stated and certainly not by untrained operators.

No evidence is offered to support the bald statement that cost of treatment by spraying is reasonably comparable with that of smoke treatment. Having regard to the fact that the spray has to be directed carefully to all parts of the surface of the ships' hold this could not be effected without the employment of ladders, steps, scaffolding, or other forms of elevation, all of which require to be moved frequently. The cost in time and labour would be substantial. Users of smokes regard them as very economical and efficient and, without further factual evidence, the contentions of the authors of the paper seem to be at variance with the facts.

There is much greater chance of taint to foodstuffs and the like arising from the liquid and strongly smelling malathion than from the dry powdery deposits of DDT and lindane smoke generators and this important fact has been omitted from the paper.

E. H. Wheelwright,
Waeco Limited.

Sir,–In reply to Mr. Wheelwright we should like to make it clear that the main object of the paper was to describe the use of the recently introduced spraying technique. We were unaware of the Editorial Subheading prior to the publication of the paper. The usefulness of insecticidal smoke generators under given conditions is accepted and is mentioned in the paper together the more important fact that the increasing use of malathion for stored products pest control necessitates the use of suitable sprayers for such places as ships' holds. This is because malathion cannot be formulated at suitable strengths in smoke generators as explained in our paper.

We feel that the method of assessing insecticidal residues by deposition on filter papers is not uncommon and no more unrealistic than any other methods that could conveniently be used under the testing conditions. Applied at the correct rate quoted in our paper very little "run-off" should be encountered. It is agreed that on horizontal surfaces smoke deposits should lead to a more even deposit. With spraying it is almost certain that very small areas may receive little spray. Results in the ship's hold quoted in Table II of our paper, and on at least three other ships where similar measurements were carried out showed that the average deposit on vertical surfaces is substantially greater than that obtained from smoke deposits. The lowest malathion deposit of 12mg. is higher than all but two of the smoke deposits.

There would be no practical justification for determining deposits only on horizontal surfaces. In the modern cargo ship welded deck plates mean that the major horizontal surface available in an empty hold is free of cracks and this surface is a fraction of the vertical surfaces against which infested cargo has been stored. The available cracks between stringers and angular supporting ribs comprising the sides of a hold provide the major harbourage for crawling insects against which insecticidal treatment is required.

Care was of course taken to see that as uniform a spraying as possible was carried out. The variation in deposits demonstrate that there was no deliberate spraying of test papers. The spraying times were as stated and similar times in proportion to the areas treated have been obtained on many other ships. The use of untrained operators for such work is undesirable, but a minimum of supervision is required for an untrained operator to understand and thereafter use these machines. The very fact that ladders, steps, scaffolding, or similar equipment is not required when spraying ships' holds with these power-operated knapsack sprayers was one of the primary reasons for investigating their usefulness. There has, in fact, been an increase in the number of spraying treatments carried out on ships.

We have not heard of any substantiated cases of taint following the very wide use in recent years of malathion in the stored products field. The admittedly strong smell of malathion is apparent only at the time of application of this chemical. There are examples of tainting however, following the use of BHC.

D. S. Papworth and F. R. Cann,
Pest Infestation Laboratory,
Slough.

NEW PUBLICATIONS

"Official Methods of Analysis of the Association of Official Agricultural Chemists."

Edited by William Horwitz.
Published by the Association of Official Agricultural Chemists, Washington, D.C., U.S.A., price 18 *dollars.*

The Association of Official Agricultural Chemists—fortunately more familiarly known as the A.O.A.C.—is the professional organisation of U.S.A. State and Federal chemists concerned with developing, testing and approving methods for analysis of fertilizers, pesticides, disinfectants, foodstuffs, drugs, cosmetics and so on. It accepts the responsibility of providing the authorities concerned with enforcement of the Federal Food, Drug and Cosmetics Act with accurate and reproducable methods of analysis for chemicals coming within their jurisdiction.

Official A.O.A.C. methods of analysis are given in this, the 9th edition of their handbook for a number of pesticides and for determination of residues of some of them in food. The methods included are those adopted at the 1959 and previous meetings of the Association. Considering the wide range of pesticides used in the United States the number of analytical methods given the stamp of A.O.A.C. official approval is surprisingly small. It seems that the Associations' procedure of collaborative analysis has been overwhelmed by promulgation of over 2,000 tolerances for more than 100 pesticide chemical residues on specific raw agricultural commodities. Of a limited, but unspecified number, of residue methods tested by the collaborative proceedure, only eight have been found suitable for adoption by the A.O.A.C. during the five years prior to 1959 and in some cases the method is only applicable to a few crops. The new methods included are for Aramite, BHC, captan, malathion, methoxychlor, piperonyl butoxide, Sulphenone and tetramethylthiuram disulphide. The mere recital of this list adds force to the Association's plea that more time and facilities must be made available for research and testing before adoption of methods can hope to keep pace with promulgation of regulations. It may perhaps sound a note of warning for those who see in hasty legislation an easy solution to problems arising from application of pesticides to crops.

Chemists concerned with analysis of agricultural chemicals will find "Official Methods of Analysis of the A.O.A.C." an indispensible work of reference. It would be useful if future editions could be divided into sections published as separate volumes.

Weed Control Handbook. 2nd Edition

Edited under the direction of E. K. Woodford.
Published by Blackwell Scientific Publications, Oxford, price 17/6.

Admitting that my artistic taste is apt to be totally different from that of anyone else, the first thing that caught my eye was the attractively designed jacket, not that it is lavish and exotically coloured just —for the want of a better word 'eye catching'.

The preface, written by Dr. H. G. Sanders, Chief Scientific Advisor to the M.A.F.F., President, British Weed Control Council, states—"The handbook is intended for all who are interested in the practical or technical aspects of the subject and the aim has been to make the volume complete; to cover all questions that can arise in the chemical control of weeds. Thus it deals with those weedkillers that are established in use and also gives the available information about those which are not yet fully proven, their chemistry their effects and recommended dosages. It lists the weeds and their susceptibilities, the crops and their resistance. Methods of application are described and sections are devoted to such matters as spray drift and the legal aspects of herbicide use"

This concise statement of the coverage of the book is in keeping with the clear and concise nature of the contents but this is hardly surprising as the material was prepared by the Recommendations Committee of the B.W.C.C.; was edited at the A.R.C.'s Weed Research Organization and the National Vegetable Research Station and is unique in that it is an agreed statement by the principal interested commercial and official bodies. To satisfy all parties it therefore has to be clear, factual and up to date.

That the rapid developments in chemical weed control have necessitated the publication of a second edition only two years after the publication in 1958 of the first Weed Control Handbook is no derogatory reflection on the value of the book merely a sign of the jet age in which we live. Indeed in the short space of time since this edition went to press several new facts have emerged, for example the two chemicals 'Carbyne' and 'Avadex' mentioned as only having undergone trials for the control of wild oat (*Avena fatua*) are now available commercially, *N*-1-naphthyl-phthalamic acid has been given the B.S.I. Recommended Common Name naptalam, as has DMTT (dazomet) 2,4,5-TP (fenoprop) and one or two others. However, these are minor points and do not detract from the value of the handbook which, according to the publishers, "is indispensible to all concerned with chemical weed control, from the agricultural expert to the week-end gardener". We would agree with the publishers so long as the weekend garden was a pretty large one or the gardener is so lazy that pulling one or two weeds from between three rose bushes is too much of an effort.

There are at least 18 new herbicides, notably the substituted triazines and certain acetamides, included in the 2nd edition which were not even mentioned in the 1st edition and herbicides which were only just mentioned in the 1958 version are now given fuller treatment with recommended dosage rates etc., so that many owners of the first edition may well find this edition worth adding to their library.

One could imagine that with the addition of a key, including diagrams and photographs for the correct identification of weed species and some provision for the addition of supplementary information either by the owner or in the form of supplements issued from time to time by the authors, all other books on chemical weed control could be dispensed with for the majority of practical purposes.